THE WEATHER AND CIRCULATION OF JANUARY 1964

Mild in the North but Cold in the South

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1. WEATHER SYNOPSIS

January 1964 was a rather mild month over the United States, with average temperatures above normal in 56 percent of the country. This was in sharp contrast to the severely cold Januarys of 1962 and 1963 when only 12 percent and 5 percent, respectively, of the Nation had temperatures higher than normal. Fast westerly flow and a wave pattern of small amplitude this January accompanied unusual warmth across the northern States, while cold weather prevailed in the South. Near-record amounts of precipitation fell in the Southeast, and heavy amounts also occurred along the northern Pacific coast. The Far Southwest was very dry, and a deficiency of precipitation continued in the Midwest.

The outstanding weather event of the month was the severe snowstorm and blizzard in the East on the 11th–14th. This storm spread a deep blanket of snow from the Middle Mississippi Valley to the Atlantic coast. Greatest depths were in the Northeast where Williamsport, Pa., reported 2 ft., the largest snowfall amount from a single storm in a record dating back to 1896.

2. MONTHLY CIRCULATION PATTERNS

700 MB.

The mean planetary flow at 700 mb. (fig. 1) and its height anomaly (fig. 2) for January 1964 indicate that zonal flow prevailed over most of the Western Hemisphere, while meridional flow dominated the Eastern Hemisphere. Most ridges and troughs were near their normal January positions [1], and the observed wave number was about as expected.

The circulation in the Pacific consisted primarily of broad cyclonic flow with a deeper than normal trough in the Bering Sea. At the same time the subtropical Highs were stronger than usual and north of normal. As a result fast westerly flow prevailed over the Pacific. Along the 40th parallel in eastern areas, wind speeds near the 700-mb. jet axis (fig. 3) were as much as 10 m.p.s. above normal.

Fast Pacific westerlies spread eastward into the ridge in western Canada, where heights averaged below normal for the month (fig. 2). Blocking from the Atlantic weakened the trough in eastern Canada, while in the United States the mean trough extending from the Middle Mississippi Valley to Mexico was in part dynamically produced by fast flow across the Rocky Mountains.

The circulation became meridional over the Atlantic, and large-amplitude flow was observed in Europe and Asia. A strong blocking ridge over western Europe was associated with a typical "omega" pattern of flow, with the trough in the eastern Atlantic assuming a sharp negative tilt. The downstream trough was located in eastern Russia and was unusually deep (540 ft. below normal in fig. 2). Vorticity flux from this large-amplitude wave system helped to establish a mean ridge over central Siberia about 10° east of its normal position. The principal 700-mb. jet axis was well defined from the Atlantic across Asia (fig. 3) and wind speeds in the jet were faster than normal with departures of 10 m.p.s. in Finland. In contrast, wind speeds in the High in southwestern Europe were well below normal.

SEA LEVEL

Characteristics of the mean sea level circulation for January 1964 (fig. 4) were similar to those of the upper-level circulation (fig. 1). On figure 4 are also shown the principal tracks of daily migratory Low and High centers. These were determined by an analysis of the number of cyclone and anticyclone passages (within equal-area quadrilaterals of 66,000 n. mi.^{2}) across North America and adjacent oceans. For the remainder of the hemisphere the principal charts consulted were the daily weather maps. These primary tracks in January were close to their climatologically preferred paths [2].

The Aleutian Low in the Pacific was much deeper than usual, as much as 15 mb. deeper near the center which was displaced 20° of longitude east-northeast of its normal position [1]. This mean Low was most intense in the period January 21–25, largely as a result of one storm that had central pressures lower than 960 mb. for two days as it moved slowly over the central Aleutians.

Except for the southwestern United States, sea level pressures averaged below normal over all of North America. Departures were as much as 10 mb. in western Canada where "Alberta" Lows were very prominent in

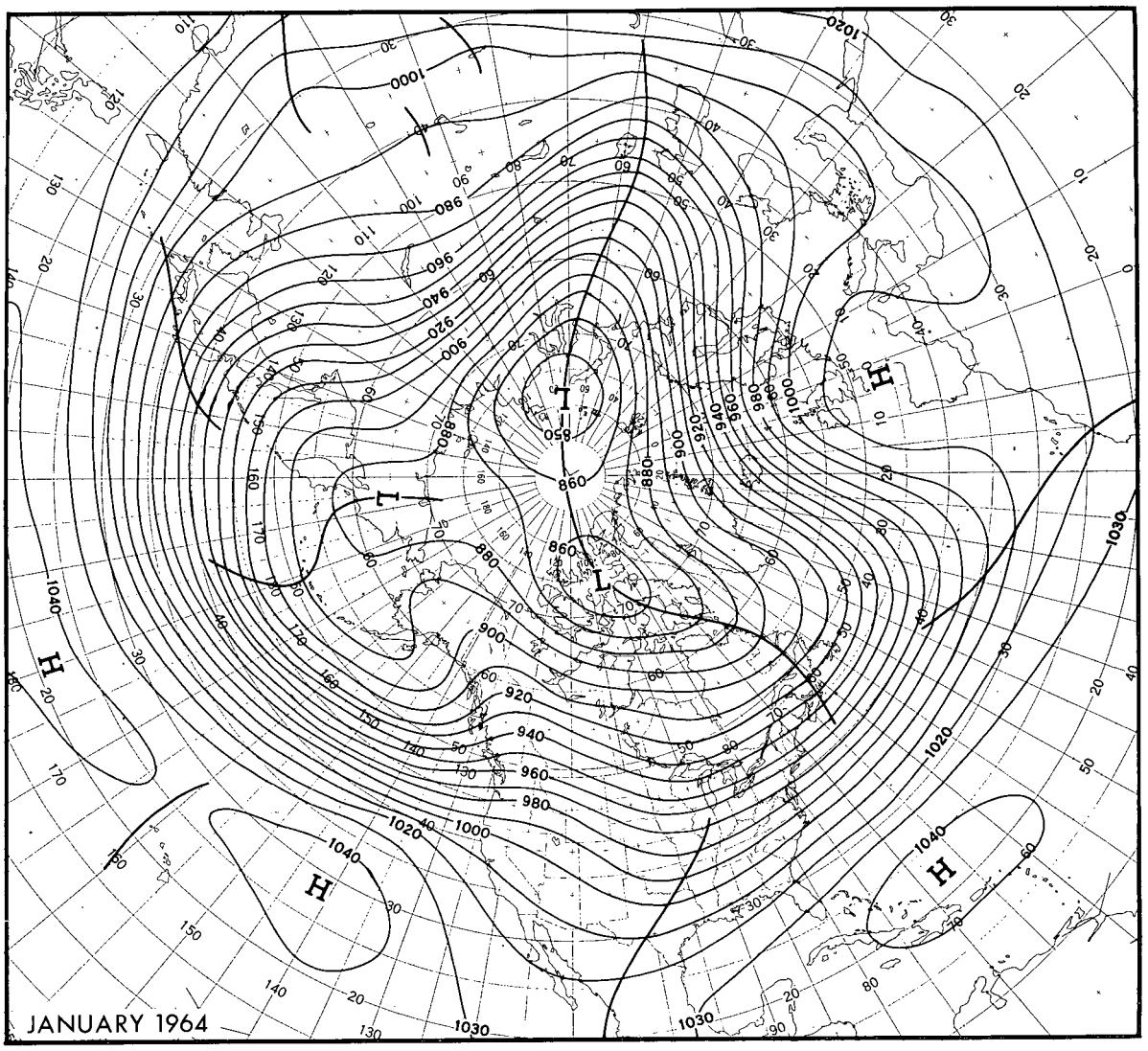


FIGURE 1.—Mean 700-mb. contours (tens of feet) drawn at intervals of 100 ft. for January 1964. Zonal flow characterized the western portion of the Hemisphere.

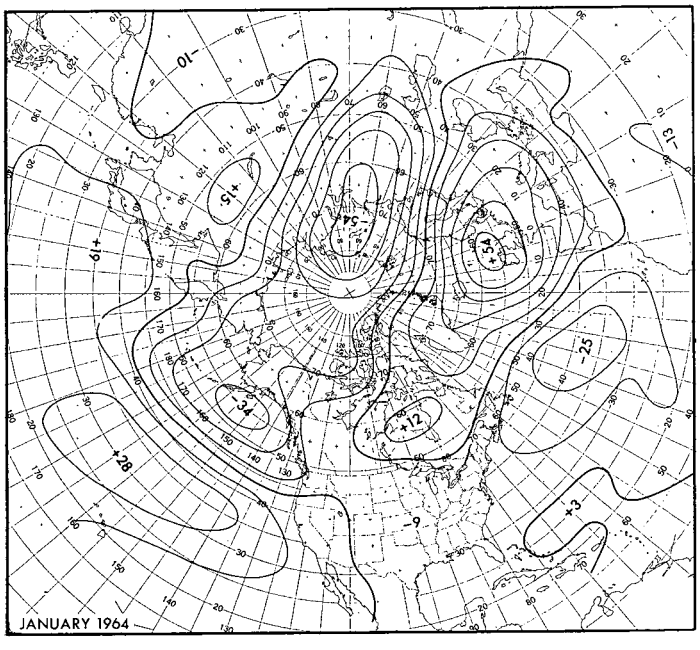


FIGURE 2.—Mean 700-mb. height departures from normal for January 1964 drawn at intervals of 100 ft., with centers labeled in tens of feet and the zero isopleth heavy. Strong gradient in the eastern Pacific reflects fast westerlies.

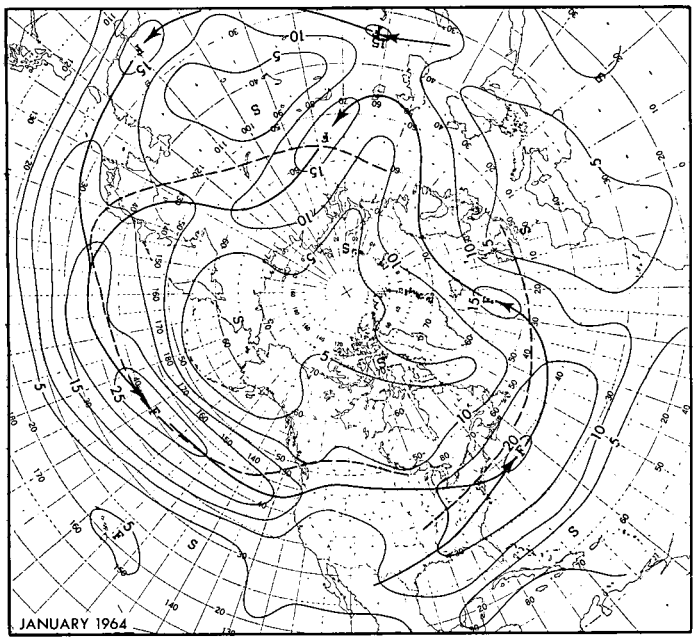


FIGURE 3.—Mean isotachs (meters per second) at 700 mb. for January 1964. Solid arrows indicate the observed primary axes of maximum west wind speed, dashed lines the normal. The westerlies averaged close to their usual position over the Western Hemisphere but were stronger than normal.

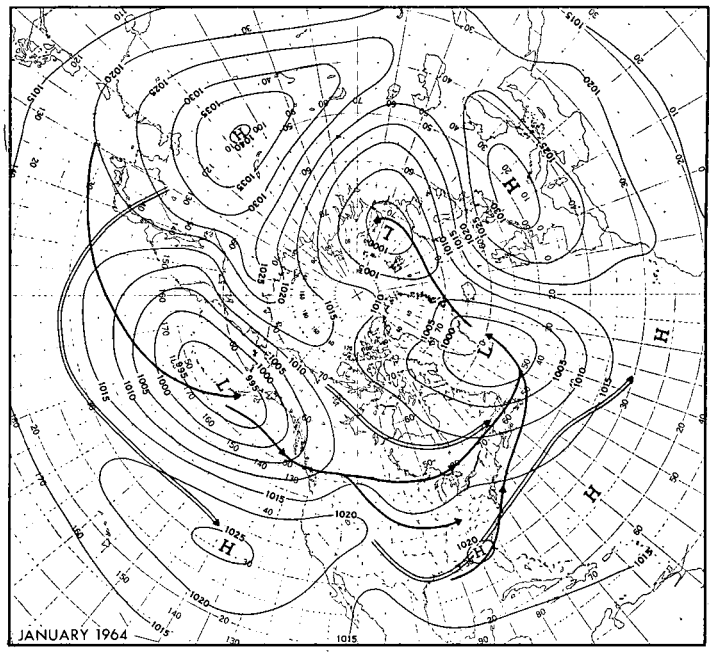


FIGURE 4.—Mean sea level isobars drawn at intervals of 5 mb. for January 1964. Principal tracks of daily migratory pressure centers are indicated by heavy solid arrows (for Lows) and open arrows (for Highs). High frequency of storms across mid-North America helped confine cold anticyclones to Canada.

January. Because of the small-amplitude wave pattern over North America, Canadian Highs were deflected along a track that precluded extensive penetration of Arctic air into the United States (fig. 4).

Westward extension of blocking from the strong ridge in western Europe, shown by the area of positive height anomaly in figure 2, effected southward displacement of North Atlantic storminess. Sea level pressures were below normal in much of the Atlantic, particularly in central areas where they averaged up to 10 mb. lower than normal. Severe storminess near the Azores was replaced by anticyclonic conditions during the latter part of the month as the upper trough was displaced by a ridge and the mean sea level High in Europe moved southwestward. The most intense storm of the month in the Atlantic was observed on the 1st when sea level pressure reached 938 mb. This storm had its origin off the South Atlantic coast of the United States and followed closely the principal track in figure 4.

Pressures averaged above normal over all of Europe (as much as 17 mb. in Germany), and southward into North Africa, as a large High dominated the continent. As a result of strong anticyclonic circulation, unusually dry weather prevailed in much of Europe with mild temperatures in the North and cold in the South. The deep Low near Novaya Zemyla was associated with a large area of below-normal pressures which extended across U.S.S.R. to central Siberia. Here the Siberian High was slightly south of its usual position and a little stronger than normal. This High gradually increased in intensity during the latter part of the month as the upper ridge strengthened, and daily pressures exceeded 1050 mb. over a wide area by the end of January.

3. AVERAGE WEATHER IN THE UNITED STATES

TEMPERATURE

The temperature anomaly pattern for January 1964 (fig. 5) shows that warmer than normal conditions prevailed across the northern half of the Nation while below normal temperatures dominated the southern half. Greatest departures, as much as 8° to 10° F. above normal, were observed in the Northern Plains and Upper Mississippi Valley. Mild weather was the result of westerly flow aloft and at the surface which transported Pacific air across the middle of North America. These air masses accompanied the frequent passage of Alberta Lows (fig. 4). In addition, the mean circulation patterns were favorable for foehn warming which spread eastward and southeastward from the northern Rocky Mountains.

Below normal temperatures from the Middle Atlantic States to the Southern Plains were principally the result of one cold period (Jan. 10–16) when temperatures averaged 16° F. below normal at New Orleans, La., and 15° F. below normal at Atlanta, Ga. The cold wave accompanied a brief period of amplification of the ridge over western North America and was associated with a very cold Canadian High which moved southward from central Canada. While this High had a pronounced effect on

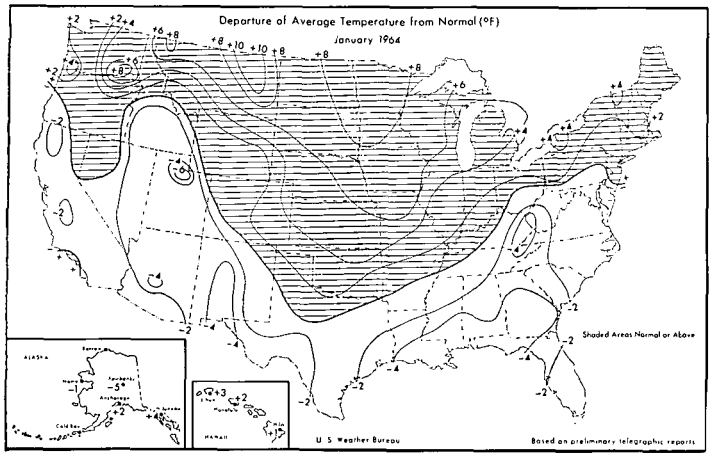


FIGURE 5.—Departure of average surface temperature from normal (°F.) for January 1964. This was the warmest January in 20 years in much of the Upper and Middle Mississippi Valley and Central Plains. (From [3].)

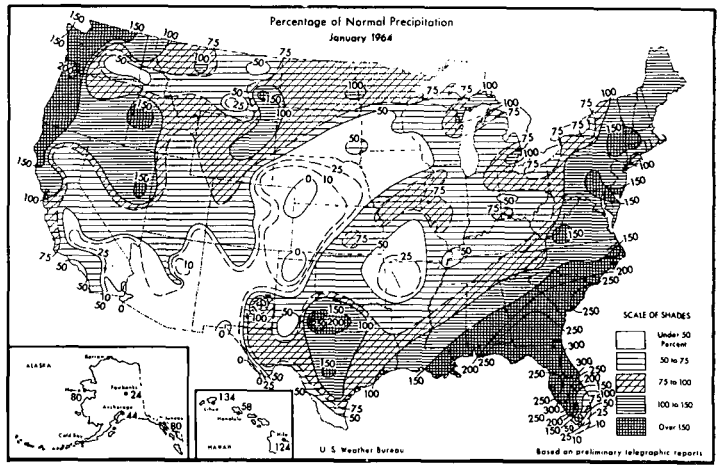


FIGURE 7.—Percentage of normal precipitation for January 1964. Precipitation was deficient in most of the area from the Rockies to the Appalachians. (From [3].)

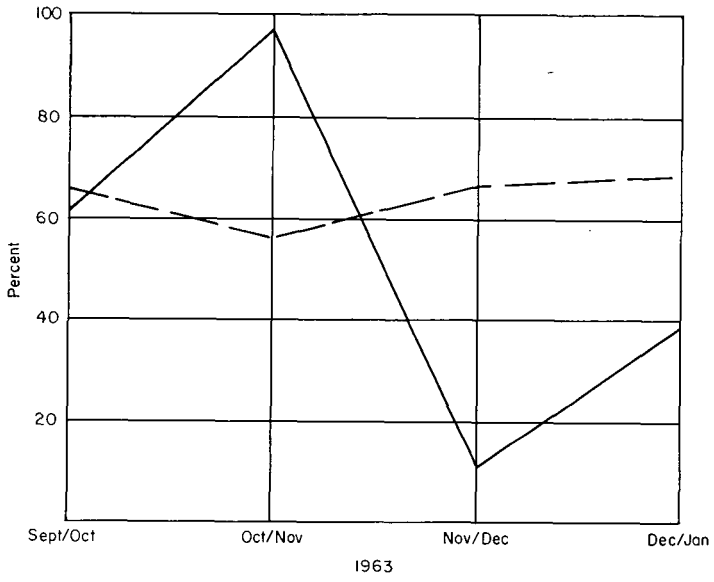


FIGURE 6.—Month-to-month persistence of temperature in the United States (except Alaska and Hawaii) from September 1963 to January 1964 (solid line). Persistence is indicated by the percentage of stations at which the temperature anomaly did not change by more than one class between consecutive months. Also shown is variation in the normal persistence (dashed line) as determined from the period 1942–1957.

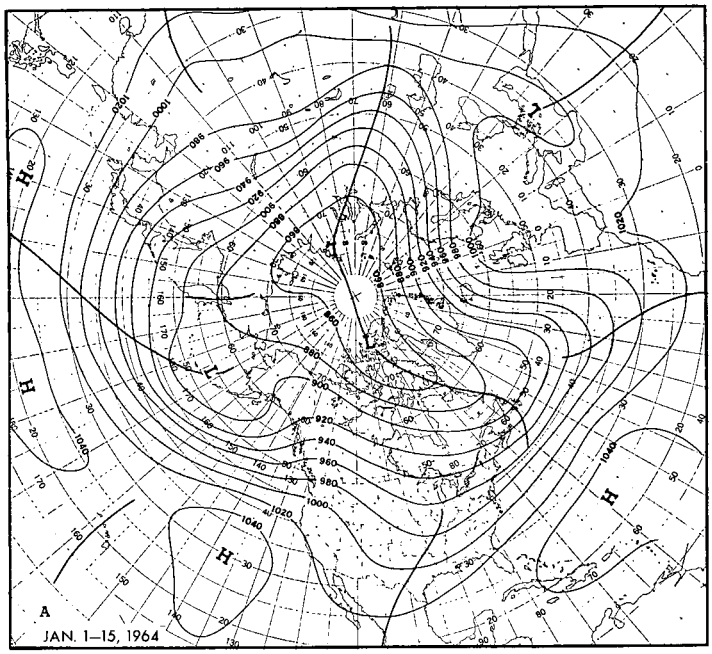
the temperature pattern in the Southeast, the principal source of anticyclones traversing the Gulf States was the Great Basin, as shown in figure 4. Below normal temperatures in the Basin and Southwest were related in part to northerly anomalous flow at 700 mb. (fig. 2). Of importance also was the presence of a snow cover in the Basin during most of the month. This aided radiational cooling, with high pressure and light winds present much of the time.

Month-to-month persistence of the temperature pattern has shown marked variation in recent months (fig. 6). Both October and November 1963 were very warm months and persistence of temperature was extremely high. December turned very cold over most of the Nation and persistence was unusually low. It was again quite low from December to January as the country became warmer, with respect to normal. Of 100 nearly evenly distributed cities across the United States 85 warmed by one or more classes, 7 showed no change, and 8 became colder. The change to cooler occurred in a small area of the Far Southwest.

PRECIPITATION

Except in the area east of the Appalachian Mountains and in the Northwest, much of the Nation had a precipitation deficiency in January 1964 (fig. 7). In the Central Plains and middle Mississippi Valley this was a continuation of a long period of moisture deficiency. The mean trough in the mid-United States (fig. 1) and the center of negative height anomaly (fig. 2) appear to favor rainfall. However, the real and anomalous flows at sea level were westerly with so weak a southerly component that moisture from the Gulf of Mexico was confined to the Southeast. Thus, the Lows moving through the Midwest (fig. 4) were generally dry, their moisture having been released west of the Rockies.

Very heavy amounts of precipitation fell in the Southeast and northward along the coast where the flow aloft became more southerly. This was one of the wettest Januarys of record in the Southeast and in some places amounts exceeded twice the normal. The precipitation was well distributed throughout the month and was related primarily to storms developing over the Gulf of Mexico and moving up the Atlantic Coast (fig. 4). Extreme southern Florida was quite dry, however, with Key West reporting only 0.06 in. of precipitation, its second driest January of record (since 1870).



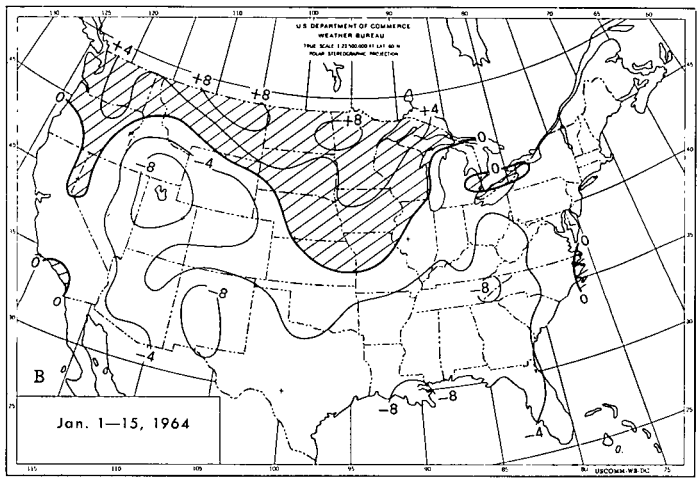
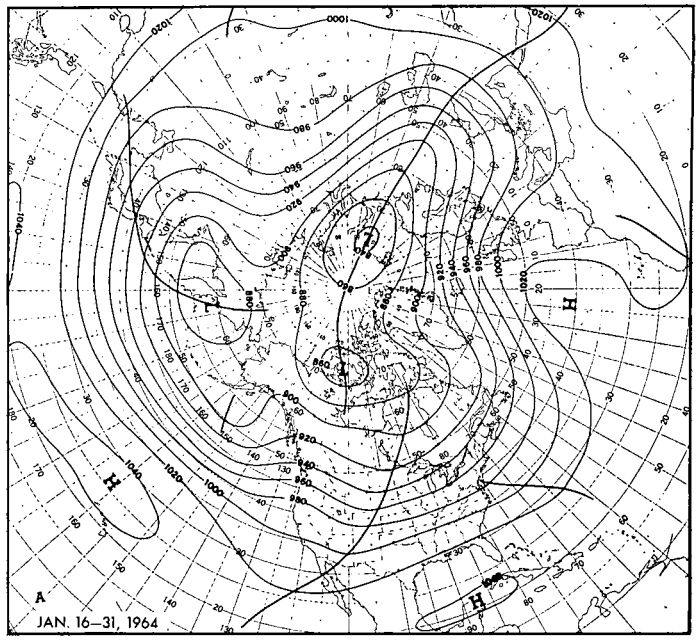


FIGURE 8.—(A) Mean 700-mb. contours (tens of feet) drawn at intervals of 200 ft., and (B) departure of average temperature from normal (° F.) for January 1–15, 1964. Areas of above normal temperature in (B) are hatched.



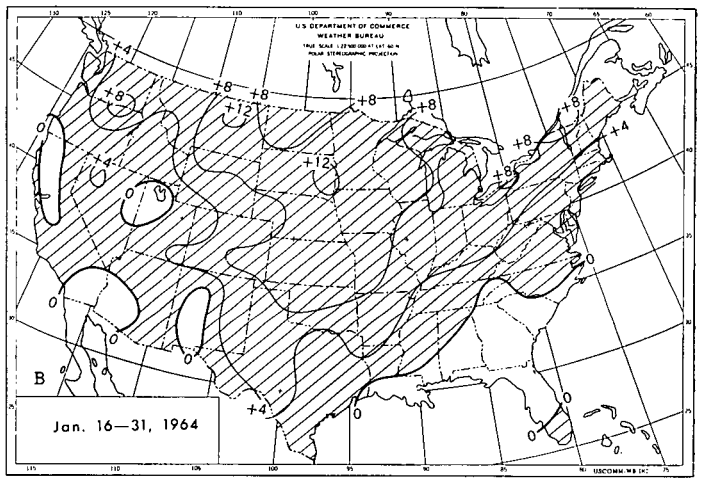


FIGURE 9.—(A) Mean 700-mb. contours (tens of feet) drawn at intervals of 200 ft., and (B) departure of average temperature from normal (° F.) for January 16–31, 1964. Areas of above normal temperature in (B) are hatched.

Heavy precipitation also fell in the Pacific Northwest where storms associated with the 700-mb. jet (fig. 3) kept the weather cloudy and wet nearly the entire month. At Seattle, Wash., there were 28 days on which either a trace or more of precipitation fell. Trailing fronts from these Pacific storms brought frequent snows to the central Plateau where total snowfall for the month was above normal. At Ely, Nev. the total fall of 19.3 in. was the greatest monthly snowfall for any January of record.

Dry weather accompanied the cold in the Far Southwest as northerly flow at sea level and aloft inhibited precipitation. At the end of January no measureable precipitation had fallen at El Paso, Tex. since November 25, 1963.

4. INTRAMONTHLY CHANGES IN WEATHER AND CIRCULATION

A pronounced warming trend in the United States during the latter part of January can be related to important changes in the mid-tropospheric circulation. This is best seen by examination of the half-monthly mean patterns of 700-mb. height and temperature (figs. 8, 9).

The planetary wave pattern for January 1-15 (fig. 8A) was remarkably similar to that for the month (fig. 1), but the ridge over western North America was stronger during the half-month period. The temperature pattern for the first half of the month (fig. 8B) reflects this dif-

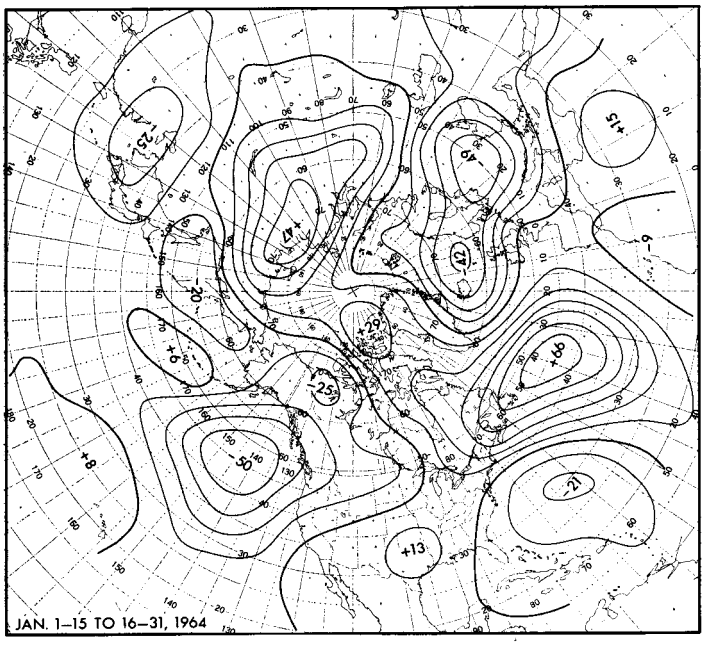


FIGURE 10.—Change in 700-mb. height (drawn at intervals of 100 ft. with centers labeled in tens of feet and zero isopleth heavier). Height falls in the eastern Pacific and western North America accompanied warmer weather in the United States.

ference in amplitude and temperatures then were lower than those for the month (fig. 5).

This period was highlighted by a severe storm which developed in the Midwest on the 11th and then swept eastward. Heavy rains fell in the Southeast, but to the north there was snow from the central Plains to the Atlantic coast. Blizzard and near-blizzard conditions prevailed in the Northeast where strong winds piled the snow into deep drifts and traffic was disrupted for several days in some places. Snow depths of a foot or more were reported throughout Pennsylvania, southeastern New York, and portions of southern New England and northern New Jersey. The most widespread cold of the month accompanied and followed the storm, with daily minimum temperature records set on the 14th at Evansville, Ind. (−6° F.), Pittsburgh, Pa. (−6° F.), and San Antonio, Tex. (15° F.); and on the 15th at Elkins, W. Va. (−12° F.), and Richmond, Va. (0° F.).

Marked weakening of the ridge in western North America and a southwestward movement of the Low near Baffin Island (fig. 9A) increased the westerlies across the United States in the latter half of the month. To some extent this change was related to evolution of the circulation elsewhere in the hemisphere. In the Atlantic, for example, the deep trough of the first half of the month was replaced by a ridge. This effected retrogression of the wave pattern across Europe, Asia, and the western Pacific. Westward motion of the principal Pacific trough to the Asiatic coast was also associated with a strengthening of the Siberian ridge. The increased wave spacing across the Pacific combined with retrogression of the eastern Pacific High to produce a trough in the Gulf of Alaska and increased cyclonic flow to the south.

These changes in circulation are readily seen in figure 10, which presents the change in 700-mb. height from the first half of the month to the last half. Note particularly the large area of height decreases in the eastern Pacific and western North America.

The entire country became warmer, with only the Southeast and a few small areas in the West showing below normal temperatures (fig. 9B). Warming began in the Northern Plains and Far West, and by the 20th nearly the entire Nation was experiencing above normal temperatures. Record daily maximum temperatures were established at many stations in the central Plains and Middle Mississippi Valley, mostly in the period January 21 to 23. Among these were St. Louis, Mo., and Evansville, Ind., each with 70° F. on the 22d. This "January thaw" caused a rapid disappearance or reduction of the snow cover left by the severe storm discussed earlier.

Storminess increased along the west coast in the last half of the month from the presence of the eastern Pacific trough. One storm, intensifying rapidly as it moved in from the Pacific on the 19th, brought winds of 72 m.p.h. to Tatoosh Island, Wash., and the lowest sea level pressure ever recorded at that station (967 mb.).

REFERENCES

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2. W. H. Klein, "Principal Tracks and Mean Frequencies of Cyclones and Anticyclones in the Northern Hemisphere," *Research Paper* No. 40, U.S. Weather Bureau, Washington, D.C., 1957, 60 pp.
3. U.S. Weather Bureau, *Weekly Weather and Crop Bulletin, National Summary*, vol. LI, Nos. 5 and 6, Feb. 3 and 10, 1964.

CORRECTION

Vol. 92, March 1964, p. 146: Reference 4 should read: J. F. O'Connor, "The Weather and Circulation of January 1963—One of the Most Severe Months on Record in the United States and Europe," *Monthly Weather Review*, vol. 91, No. 4, Apr. 1963, pp. 209–217.

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